NRI research highlights

NATIONAL RESEARCH INITIATIVE COMPETITIVE GRANTS PROGRAM

United States Department of Agriculture

Cooperative State Research, Education, and Extension Service

September 2000

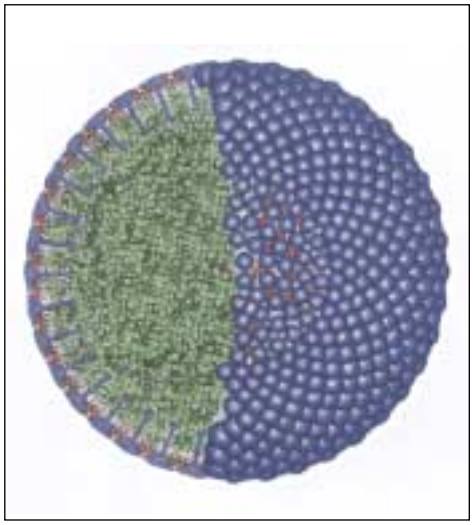
Basic Research into Oleosin Affords Many Practical Uses

Anthony H. C. Huang, University of California at Riverside

In seeds, a layer of protein called oleosin covers subcellular oil bodies, which store the oil reserves needed for germination. Oleosin is especially abundant in oil seeds such as canola and sunflower and represents about 10% of seed proteins.

The semi-water-soluble oleosin molecules anchor on the oil bodies and stabilize the water-insoluble oil droplets in the cellular water environment. The small but numerous oil bodies within a cell provide a large total surface area, which facilitates mobilization of the oil reserves and thus germination.

Seeds of some tropical species – such as chocolate beans – do not have oleosin on the oil bodies. At lower temperatures the oil bodies fuse together and damage internal cell structures. These tropical seeds do not survive very long.



IN THIS MODEL OF A SEED OIL BODY, THE OIL (GREEN), THE PHOSPHOLIPID (RED), AND OLEOSIN (BLUE) ARE SHOWN IN PROPORTIONAL SIZES. THE SIZE OF THE OIL BODY RELATIVE TO THE MOLECULES IS DIMINISHED TO REVEAL THE SURFACE STRUCTURE.

Recently, researchers have discovered that oleosin is also abundantly present on the pollen surface of many agricultural crops. Oleosin and lipids are synthesized in the cells lining the pollen sac in flowers and are deposited uniformly onto the surface of the maturing pollen. This is possible because of the semi-water-soluble, emulsifying nature of oleosin.

On the pollen surface, the lipids form a waterproof layer to protect the pollen. The oleosin serves as a wick, drawing water from the surface of the female component of the flowers for pollen germination, necessary for fruit and seed production.

With support from USDA's National Research Initiative (NRI) Competitive Grants Program during the past decade, researchers at the University of California at Riverside have been studying oleosins in seeds and flowers.

Foreign Proteins

The researchers have used oleosin in seeds to mass-produce useful foreign pro-

Basic research into oleosin has led to many applications to enhance agriculture, medicine, and other industries for the well-being of society.

teins in crops via genetic engineering. The design takes advantage of the abundance and the structural flexibility of oleosin and its association with low-density oil bodies.

With genetic engineering, a gene that can produce a fusion protein – a foreign protein linked to oleosin – is made artificially and put into a crop plant. The plant then produces fusion protein, which resides in the seed on the surface of the oil bodies.

During harvest, seeds are ground and low-density oil bodies are collected by flotation. The foreign protein is cleaved from oleosin on oil bodies, and remaining oil bodies are removed by flotation again. The operation inexpensively yields the foreign protein in a pure preparation.

Impact

Basic research into oleosin has led to many applications to enhance agriculture, medicine, and other industries for the well-being of society. Oleosins can be modified by gene cloning to produce foreign proteins for medical and other industrial purposes.

On the horizon, oleosin may be used as a natural food and non-food emulsifier or to enhance the longevity of tropical seeds.

Researchers are using the pollen oleosin to deliver foreign proteins to the pollen surface via genetic engineering. These foreign proteins could inactivate the pollen to simplify hybrid seed production or promote self-fertilization of an individual plant to enhance seed and fruit production.

They could also inoculate commercially important pollinators against diseases and pests and negate the allergens released from the pollen. They could even render the pollen nonviable, to prevent genetically engineered pollen from fertilizing other plants and thus stopping the escape of undesired genes into the environment.

The research reported in this factsheet was sponsored by the Plant Genetic Mechanisms Program of the Plants Division of the National Research Initiative Competitive Grants Program. To be placed on the mailing list for this publication or to receive additional information, please contact the NRI (202/401-5022 or NRICGP@reeusda.gov). The factsheet also is accessible via the NRI section of the Cooperative State Research, Education, and Extension Service website (http://www.reeusda.gov/nri).